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Short Note

Killer Whale (*Orcinus orca*) Harassment on Humpback Whales (*Megaptera novaeangliae*) in Offshore Brazilian Waters

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Humpback whales (*Megaptera novaeangliae*; Borowski, 1781) have a migratory pattern characterized by segregation between summer feeding areas at higher latitudes and winter breeding/calving areas at lower latitudes (Rizzo & Schulte, 2009). In the Southwest Atlantic Ocean (SWA), the Brazilian breeding stock "A" of humpback whales was heavily depleted by whaling operations during the 19th and early 20th centuries, but since then has experienced a recovery (Andriolo et al., 2010). Evidence from different research fields suggests that this population migrates in the summer from feeding areas mostly near South Georgia and the South Sandwich Islands to calving and mating grounds located off the coast of Brazil, mainly on the Abrolhos Bank, in coastal shallow waters (International Whaling Commission [IWC], 2011; Marcondes et al., 2021). Despite being commonly seen on the Abrolhos Bank, humpback whales can be found during the breeding season off the entire Brazilian coast from Rio Grande do Sul 34º S to Pará State 1º N (Pretto et al., 2009; Ristau et al., 2020).

Killer whales (*Orcinus orca*; Linnaeus, 1758) inhabit all the world's oceans, including pelagic and coastal environments and tropical waters, but are most often found in coastal regions of high latitudes and high productivity (Forney & Wade, 2006). In Brazil, killer whales are found in coastal and offshore waters (Lodi & Hetzel, 1998; Siciliano et al., 1999; Dantas, 2007; Wedekin et al., 2014). On the coast of southeastern and southern Brazil, small killer whale groups of mixed age and sex are observed exhibiting a certain degree of fission-fusion dynamics, with solitary adult males also observed in the region (Athayde et al., 2023). These killer whales perform long- and short-distance movements between this area and also off Uruguay's coast that seem to be erratic and driven by foraging opportunities; they also exhibit a generalist feeding behavior, which does not rule out the possibility of groups with specialized diets in the region (Athayde et al., 2023).

Behavioral observations and stomach contents reveal ecological prey diversity in killer whales that frequent Brazilian waters. They have been observed preying on teleost fish, rays, sharks, and penguins (Castello, 1977; Dalla Rosa, 1995; Lodi & Hetzel, 1998; Secchi & Vaske, 1998; Fernandes, 2001; Dalla Rosa & Secchi, 2007; Dantas, 2007; Monteiro, 2008; Wedekin et al., 2014; Passadore et al., 2015; Athayde et al., 2023). Analyses of stomach contents found salps, a variety of cephalopod species, and teleost fish (Dalla Rosa, 1995; Santos & Haimovici, 2001), as well as the presence of some cetaceans such as Burmeister's porpoises (*Phocoena spinipinnis*) and franciscana dolphins (*Pontoporia blainvillei*) (Dalla Rosa, 1995; Ott & Danilewicz, 1998). Killer whales have also been observed preying on a minke whale (*Balaenoptera acutorostrata*) and a franciscana dolphin in the region (Santos & Netto, 2005; Troina et al., 2020). In 2012, a group of four killer whales were observed harassing a sperm whale (*Physeter macrocephalus*) calf offshore off Rio Grande do Sul, southern Brazil (Sucunza et al., 2022); and, in 2019, an interaction between a mother–calf pair of southern right whales (*Eubalaena australis*) and at least four killer whales with no evidence of attacks was recorded on the south coast of Brazil (Renault-Braga et al., 2019). In 2018, Bryde's whales (*Balaenoptera brydei*) were sighted in a brief interaction with killer whales in the northeast of Ilhabela Archipelago, southeastern Brazil, also without evidence of attacks (Athayde et al., 2023). Ott et al. (2017) reported a female newborn southern right whale found dead in 2008 on the northern coast of Rio Grande do Sul, which exhibited several teeth marks compatible with killer whales on the back and belly, on the right pectoral

fin, and on the left fluke margin. In 2019, a video shared on the Internet shows interaction between humpbacks and killer whales off the coast of Bahia where there is greater water movement, but it was not clear whether it was an attack or not. In 2021, another video posted to the Internet shows a group of killer whales attacking or harassing a humpback whale off the coast of Rio de Janeiro; this time, there was evidence of blood in the water, but the sequence does not include the outcome (Athayde et al., 2023). In 2023, killer whales were also seen harassing a mixed group of five humpback whales and one adult southern right whale (Maciel et al., 2024).

Herein, we describe the harassment by killer whales on a pair of humpback whales in offshore Brazilian waters. This observation was made on 2 August 2023 during daily monitoring of cetaceans from a fixed oil drilling platform in Campos Basin (23° 05.031' S, 40° 59.738' W) that is located in 100 m water depth, close to the continental shelf break, 129 km offshore from Arraial do Cabo in Rio de Janeiro, southeastern Brazil (Figure 1). Surveys by a biologist, one of our co-authors (SPB) who has experience in watching marine mammals, were conducted daily, from sunrise to sunset with a rest interval of 1 h (~1045 to 1145 h). Observations were made with 7 × 50 Lugan binoculars calibrated to estimate the distance of events during daylight. Photos were taken with a Canon Rebel EOS Rebel T2i camera. Sea conditions at the time were favorable (Beaufort scale 2) with moderate visibility (2 to 5 km range), swells between 2 to 4 m, and winds blowing northwest at 19 km/h.

The recording started at 1317:55 h (all times reported are local time) when a group of three to five killer whales were observed chasing two humpback whales that came from the east side of the platform traveling towards the south side. At 1318:03 h (Figure 2A), the two humpback whales were seen still swimming towards the south until, at 1319:01 h (Figure 2B), when killer whales approached to within a few meters of the humpbacks. At this approach, the humpback whales rapidly changed direction to the east. At 1319:05 h (Figure 2C), the killer whales surrounded the humpbacks. At 1319:58 h (Figure 2D), the killer whales chased the humpbacks at a greater speed than initially observed (Figure 2E). At 1321:06 h (Figure 2F), the two humpbacks were seen together and, between 1321:31 and 1322:30 h, the killer whales were seen swimming faster alongside the humpbacks and with increased respiration rates (Figure 2G & 2H, respectively). At 1322:55 h, the humpbacks were still seen together swimming west from the platform (Figure 2I). At 1326:56 h, three killer whales were seen swimming and breathing synchronously close to each other a few meters behind the humpbacks (Figure 2J & 2K, respectively). From 1328:38 h until the end of the observation, there was a lot of movement in the water, where one killer whale was seen swimming on top of one humpback at the surface (Figure 2L-2N). Between 1336:04 and 1337:29 h, the killer whale movements became faster and more agitated; they were jumping over the humpbacks (Figure 2O & 2P). From 1338:17 to 1440:47 h, only one humpback whale was seen swimming alongside one killer whale (Figure 2Q & 2R). The biologist (SPB) observed the region for another hour, but the other killer whales and the second humpback were not observed again.

Direct interactions between killer whales and humpback whales or other large whales that may

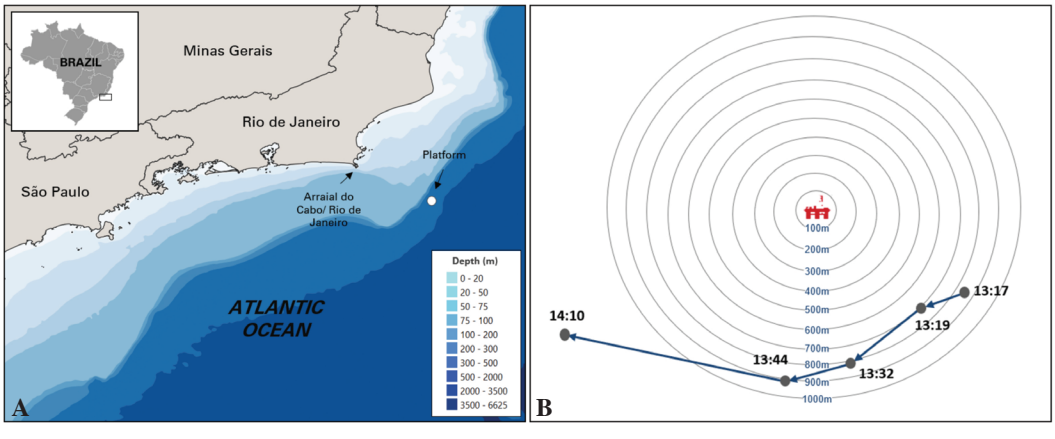

Figure 1. (A) The position of the fixed drilling platform is presented where an observation of killer whales (*Orcinus orca*) harassing humpback whales (*Megaptera novaeangliae*) was observed; and (B) a timeline of events with estimated distance(s) using calibrated binoculars between the animals and the platform from which the harassment observation is depicted.

Figure 2. Sequence of movements by a group of three to five killer whales near a pair of humpback whales in offshore waters off Brazil (Photos provided by Sara Pereira Bragança)

or may not be fatal attacks have been recorded in different regions of the world such as Antarctica (Pitman & Ensor, 2003), Eastern Tropic Pacific (Pacheco et al., 2019; Pitman et al., 2023), Eastern North Pacific (Jefferson et al., 1991; Ford & Reeves, 2008), and Western Australia (Pitman et al., 2015; Totterdell et al., 2022). In SWA, on the Argentinean coast of the Beagle Channel, killer whales were observed preying on dwarf minke whales (*Balaenoptera acutorostrata* subsp.) and sei whales (*Balaenoptera borealis*) (Capella et al., 2014). Still in the Beagle Channel, on the boundaries between the Atlantic and South Pacific Oceans but already in Chilean territory, a fatal attack on a fin whale (*Balaenoptera physalus*) was recorded (Pitman et al., 2023). There are also reports of killer whale attacks on southern right whales and minke whales in Argentina (Sironi et al., 2008; Grandi et al., 2017). When they attack large whales, however, killer whales generally seem to target smaller specimens or calves (Pitman et al., 2023) as, for example, a fatal attack was recorded on a possible adult pygmy blue whale (*Balaenoptera musculus brevicauda*) in Western Australia (Totterdell et al., 2022).

A review of the literature suggests that killer whale attacks or harassment on humpback whales and other large whales are rarely witnessed, with observations occurring opportunistically, making it hard to determine whether the attacks were fatal or not and making it difficult to measure the extent to which killer whales pose a threat to these large species (Pitman et al., 2015). Killer whale attacks on humpback whales typically leave teeth scars on the latter's tails, indicating attacks might be common but not fatal (McCordic et al., 2014; Pitman et al., 2015). Naessig & Lanyon (2004), when investigating the incidence of non-lethal predation of humpback whales in eastern Australian waters, observed that the proportion of adult whales showing scars indicative of previous killer whale attacks is low as is the presence of recent scars. Their observations support the hypothesis that humpback whales are subject to most killer whale attacks early in life, surviving them with evidence on their bodies.

In our observation documented herein, no blood nor injuries on the humpbacks were observed, making clear the harassment but not whether there was an attack or whether it was fatal (to one or both humpbacks). This interaction between killer whales and humpback whales, observed during the humpback migration in the region, offers new insights into potential killer whale prey and their relationships with other marine mammals in the SWA. It is unclear whether these interactions have increased in recent years due to the population growth of humpback whales in the region or whether they have always existed and are being recorded more frequently due to increased access by people with technology to document and monitor marine life offshore.

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